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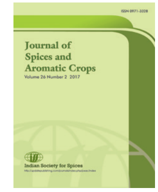

Evaluation of insecticides and a natural product for their efficacy against shoot borer (*Conogethes punctiferalis* Guen.) (Lepidoptera: Crambidae) infesting ginger (*Zingiber officinale* Rosc.)

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Abstract

Nine insecticides and a natural product were evaluated for their efficacy against shoot borer (*Conogethes punctiferalis*), a serious insect pest of ginger (*Zingiber officinale*) for two years. Pooled analysis of two years data indicated that chlorantraniliprole 0.01% was the best treatment with a mean pseudostem damage of 2.6% which was on par with flubendiamide 0.02% (4.1%), spinosad 0.0225% (6.5%) and cyantraniliprole 0.005% (8.8%), when sprayed at 15 day intervals during the second fortnight of July to the first fortnight of November. The trials indicated that that these low-risk insecticides and the natural product can be utilized for the management of *C. punctiferalis* in ginger with reduced risk to the environment.

Keywords: *Conogethes punctiferalis*, ginger, insecticide, natural product, shoot borer, *Zingiber officinale*

Introduction

The shoot borer (*Conogethes punctiferalis* Guen.) (Lepidoptera: Crambidae), is the most serious insect pest on ginger (*Zingiber officinale* Rosc.), widely used as a spice and in traditional medicine across the world. The shoot borer occurs in tropical and sub-tropical countries and the larvae infest more than 65 species of plants belonging to different families (Devasahayam & Koya 2005). The larvae bore into pseudostems and feed on the growing shoots resulting in dead hearts. When more than 50% of the pseudostems are damaged in a clump, the yield is significantly affected (Koya *et al.* 1986); severe infestations can cause yield losses up to 25% (Nybe 2001). The present management strategy for *C. punctiferalis* includes spraying malathion 0.1% (Koya *et al.* 1988) or quinalphos 0.05% + Ozoneem 1500 ppm (3 ml L^{-1}) (Mhonchumo *et al.* 2010). In spite of the serious nature of the pest, very few newly developed low-risk insecticide molecules and natural products have been screened against the pest. Trials were conducted with the objective of finding out safer insecticides and natural products for management of *C. punctiferalis* in ginger and the results are presented in this paper.

Materials and methods

Location

The trials were carried out in the experimental farm of ICAR-Indian Institute of Spices Research at Peruvannamuzhi (11°35′0″N, 75°49′0″E) in Kozhikode District, Kerala during the crop seasons of 2015-16 and 2016-17. The average annual rainfall of the location ranged from 4300 to 5300 mm.

Experimental plot

Ginger (variety IISR-Rejatha) was grown in raised beds (3 × 1 m^2) as a rain-fed crop. A spacing of 25 cm was maintained between each clump. Each bed accommodated 40 clumps and the planting was carried out in June each year. All agronomic practices recommended by ICAR-IISR *et al.* (2015) were followed except plant protection measures to raise a healthy crop.

Treatments

The treatments included nine insecticides and a natural product and control with water spray (Table 1). The trials were conducted in a randomized block design and a single bed served as a treatment. Each treatment was replicated three times. The plants were sprayed with the chemicals to the point of runoff using a high volume knapsack sprayer. The treatments were imposed at 15 days interval starting from the last week of July when the first symptom of pest infestation was observed on the tender leaves and were continued up to the first fortnight of November. The number of healthy and damaged shoots by the borer in each clump was recorded in the last week of November when the plants started drying after maturation. The data were subjected to arc sine transformation and means were separated by LSD, year-wise and pooled analysis for two years was also carried out.

Results and discussion

During 2015-16, the mean pseudostem damage was lowest (2.2%) in plots treated with chlorantraniliprole 0.01% which was on par with flubendiamide 0.02% (4.1%), spinosad 0.0225 (7.0%) and cyantraniliprole 0.005% (11.3%) (Table 1). All other treatments were on par with control. During 2016-17, plots treated with chlorantraniliprole (0.01%) had least pseudostem damage (3.1%) which was on par with flubendiamide 0.02% (3.2%), lambda-

Table 1. Screening of insecticides and natural product against shoot borer infesting ginger

Treatment	Concentration (%)	Mean pseudostem damage (%)		
		2015–2016	2016–2017	Pooled
Malathion 50% EC	0.1	25.3(29.9)cde	13.6(21.5)cd	19.5(25.9)def
Lambda-cyhalothrin 5% EC	0.01	21.7(25.8)bcde	3.4(9.5)a	12.5(19.2)bcd
Quinalphos 25% EC	0.05	17.3(23.9)bcde	10.7(19.0)bcd	13.9(21.8)cde
Fipronil 5% SC	0.0025	17.5(23.8)bcde	7.6(15.5)abc	12.5(20.4)bcd
Imidacloprid 17.8% SL	0.009	38.8(37.2)e	34.3(35.7)f	36.6(37.2)g
Thiamethoxam 25% WG	0.0125	26.8(30.8)de	29.1(31.8)ef	27.9(31.9)fg
Spinosad 45% SC	0.0225	7.0(14.6)abc	5.9(13.3)abc	6.5(14.7)abc
Flubendiamide 39.35% SC	0.02	5.0(12.2)ab	3.2(9.6)a	4.1(11.6)ab
Chlorantraniliprole 18.5% SC	0.01	2.2(8.1)a	3.1(10.0)ab	2.6(9.3)a
Cyantraniliprole 10.26% OD	0.005	11.3(18.5)abcd	6.3(14.2)abc	8.8(17.1)abcd
Control (water spray)	-	33.9(35.7)de	17.9(25.1)de	26.0(30.4)efg
LSD (P<0.05)		15.605	9.202	8.873

Values in parenthesis are arcsine transformed values. Values with different letters are significantly different from each other by LSD (P<0.05) cyhalothrin 0.01% (3.4%), spinosad 0.0225% (5.9%), cyantraniliprole 0.005% (6.3%) and fipronil 0.0025% (7.6%). All other treatments were on par with control. Pooled analysis of the data indicated that chlorantraniliprole 0.01% was the best treatment with mean pseudostem damage of 2.6% which was on par with flubendiamide 0.02% (4.1%), spinosad 0.0225% (6.5%) and cyantraniliprole 0.005% (8.8%). Plots treated with fipronil 0.0025% (12.5%) and lambda-cyhalothrin 0.01% (12.5%) were significantly superior to control; all other treatments were on par with control.

Chlorantraniliprole, flubendiamide and spinosad have been reported to be effective against *Leucinodes orbonalis* Guen. in eggplant (Saha *et al.* 2014; Sajjan & Raffe 2015; Mainali *et al.* 2015); flubendamide on *Helicoverpa armigera* (Hub.) in pigeon pea, chilli and tomato (Sreekanth *et al.* 2014; Tatagar *et al.* 2009; Ameta & Bunker 2007), and *Earias vittella* (Fab.) in okra (Bansode *et al.* 2015). Spinosad, fipronil and lambda-cyhalothrin are effective against *E. vitella* in okra (Shinde *et al.* 2011; Singh *et al.* 2015; Kumar *et al.* 2016).

The U.S. Environmental Protection Agency (2017) has classified chlorantraniliprole, spinosad and cyantraniliprole as reduced risk insecticides. In India, these insecticides including flubendiamide are categorised under low toxicity group with either green or blue labels. Spinosad (derived from the actinomycetes *Saccharopolyspora spinosa*) is considered as natural product and has been recommended for use in organic agriculture. Though various natural enemies have been recorded on *C. punctiferalis* in many crops, specific records on ginger are limited. The natural enemies recorded on the shoot borer infesting ginger include mermithid nematode, hymenopterous parasitoids and entomopathogenic nematodes that play an important role in the suppression of the pest in the field (Devasahayam 1996; Pervez *et al.* 2014) and hence use of low-risk insecticides in the ginger ecosystem is important. The findings of the present study show that the low-risk insecticides such as chlorantraniliprole, flubendiamide and cyantraniliprole and natural product such as spinosad would be ideal for developing integrated pest management strategies against *C. punctiferalis* in ginger.

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